wrote "The Piper of Hell"—"O have ye heard of Angus Blair, Who lived long since in black Auchmair?" and a more terrible and cruel ballad still—"Who hath not met Witch Margaret? Red gold her rippling hair. . . . Come up and you shall see her yet, Before she groweth still; Before her cloak of flame and smoke The winter air shall fill; For they must burn Witch Margaret Upon the Castle Hill."

Together with these Edinburgh worthies we may say a passing word of two Dublin physicians of the last generation, George Sigerson and John Todhunter. They were both of them fervid writers of Celtic poetry, and have a notable place in their country's undoubted literary renaissance. Irish patriotism inspired them both, in a way that we little understand—as when Todhunter cries out "O thou Swan among the nations, enchanted long, so long That the story of thy glory is a half-forgotten song." He was a powerful and influential singer, a true Irish Tyrtæus; for it was he who wrote "There's a spirit in the air, Says the Shan Van Vocht"; just as another learned brother-scholar and fellow of Trinity College, Dublin (not a physician, however), boldly sang: "Who fears to speak of '98?" and sang it to only too receptive ears.

But I have gone farther afield than I ever meant to go, and I have left myself all too little room to write of Sir Ronald Ross, the last of our poet-physicians. Most of his poetry was written in India, in Madras or Burma or the Andamans, while he was engrossed in the study of the pathology of malaria, and during earlier years when he began to think and dream over the eternal problems of the East. Sir Ronald's love and reverence for science, and his admiration for those who have shown and followed the way of discovery, are deeper because far more experienced than Akenside's: "Tho' we may never reach the peak, God gave this great commandment, Seek."

It is not the wealth and splendour of the East that touch his imagination; but, looking with the physician's charitable eyes, he broods over the decadence, the misery, the widespread sickness of its people: "The leprous beggars totter trembling past, The baser sultans sleep." A famine-stricken girl is suckling her three-year-old: "'I am too poor,' she said, 'To feed him otherwise,' and with a kiss Fell back and died." It is all a gloomy picture. But if its blackness be somewhat overdrawn (and I hope and think it is) its pessimism is inspired and redeemed by charity and pity, by resolution to understand, and by ambition to relieve. Sir Ronald's second volume, though tragic enough, is in a happier strain.

Only a few days ago, lecturing to my class of some eighty young men and women newly entered a week before upon their medical course, I tried to tell them what the Protozoa meant to our fathers, and what (thanks to Pasteur and Grassi and Manson and Bruce and Ross and many another) they have come to mean to us. In my student-days, an Amœba, a bell or slipper animalcule, a little ooze from the Atlantic, a few pretty radiolarian or foraminiferal shells, gave us our outline-concept of the Protozoa. To-day a new world is opened, in which we hear of tiny things with strange life-histories, of momentous chains of cause and consequence wherein rat and louse and gadfly and mosquito play their insidious part, bringing fever to the swamp and murrain to the plain; we are told at last of mysterious maladies explained, of epidemics held at bay, of territories and peoples emancipated from disease. And then, as an example of the spirit of the scientific physician, of aims conceived, of dreams come true, I ventured to read them a couple of Ronald Ross's early verses, written before he and his fellow-workers had brought their hopes to fruition:—

In this, O Nature, yield, I pray, to me.
  I pace and pace, and think and think, and take
The fever'd hands, and note down all I see,
  That some dim, distant light may haply break.

The painful faces ask, Can we not cure?
  We answer, No, not yet; we seek the laws.
O God, reveal thro' all this thing obscure
  The unseen, small, but million-murdering cause.

My students listened and went quietly away, and I could see by their faces that they had heard the words of the poet and the physician as though he were speaking straight to them.

D'ARCY W. THOMPSON.

## Movements of Plants.

*Transactions of the Bose Research Institute, Calcutta.* Vol. ii., *Life Movements in Plants.* By Sir Jagadis Chunder Bose. Pp. v+xiv+253–597. (Calcutta: The Bose Research Institute, 1919.) Price 10*s.* 6*d.*

IN this the second volume of the Transactions of the Bose Institute, Sir Jagadis Bose continues to pour out his almost overwhelming wealth of observations. The first chapter of the volume deals with a piece of apparatus to be used with

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the "high magnification crescograph" which magnifies the rate of growth up to ten million times. As, even with much lower magnifications, the spot of light or point of the lever would soon move off the scale or recording surface, the author has devised a method of balance different from the optical method originally used. In this new method the plant-holder is connected with a series of gear-wheels driven by a falling weight and controlled by a fan governor. By this means the plant-holder can be made to fall at various rates, and thus the growth of the plant is compensated, and we have what is termed the "balanced crescograph." When the rate of growth is exactly balanced the record will show a horizontal line, and any increase or decrease in the rate will be indicated by a rise or fall in the curve. By this means it is claimed that a change in the rate of growth of only 1 part in 27,000 can be detected. The method is one of great delicacy, it is clear, but, in view of the fact that the control of the speed of movement is in part frictional resistance, and also of the effect of grit and of inequality in the cutting of the gear-wheels, one would have liked to see the inclusion of a record which would demonstrate that a speed of 0·5 $\mu$ per sec. was kept constant to 1 part in 25,000 for many hours.

The volume contains thirty chapters on various plant reactions which exhibit themselves either by movements or by electrical response. Of these perhaps the most striking is the interesting contribution which the author makes to the problem of the mechanism of geotropic response. In the statolith theory of geotropism one link in the chain of reactions which bring about geotropic curvature is the shifting, under the influence of gravity, of comparatively large starch grains in a tissue such as the endodermis of the stem. This theory is upheld by the author as a result of the exploration of the plant by means of his "electric probe." The probe consists of a fine glass tube (0·15 mm. diam.) with a still finer platinum wire fused into, and projecting just beyond, it. The probe can be pushed into the tissues of a stem, while the other end of the platinum wire is connected with one terminal of a galvanometer, the other terminal being connected with some other part of the plant, *e.g.* a leaf, which is always kept horizontal. The probe is first placed on the surface of the organ, and the deflection is observed when the stem is placed horizontal; the stem is then returned to the vertical position, the probe advanced a little into the tissues, the stem again placed horizontal and the deflection observed. It is found that as the probe penetrates the deflection rises to a maximum and then falls to a minimum at about the centre of the stem. *The point of the probe in the position of maximum deflection is found to lie in the endodermis.* If the probe is carried forward towards the other side of the stem, a new maximum is found when the point reaches the endodermal layer on the other side, *but the deflection is in the opposite direction.*

This observation does not, of course, prove that the endodermis is the geo-perceptive layer, but it provides circumstantial evidence in favour of that view, since it demonstrates that the endodermis is the only tissue exhibiting a marked electrical reaction to geotropic stimulus. In one case where the angle of the stem was gradually increased there was no deflection until a critical angle of about 33° was reached, but above this there was a marked electrical response. There appears to be some frictional resistance to the displacement of the starch grains, which is not overcome until the critical angle is passed. By comparing the electrical response (which can, of course, be observed without the use of the "probe") of organs placed at angles of 90° and 45°, respectively, with the vertical, evidence is obtained in support of the view that the geotropic response is proportional to the sine of the angle.

The marked effect of temperature on the degree of geotropic response, which leads to decided diurnal movements of many stems, is a thesis which is further elaborated in this volume, as is also the difference between "direct" and "indirect" stimulation. The volume is filled with numerous and often stimulating observations carried out with the author's well-known mastery of the technique of experimentation. One must be grateful for the new weapons which he has forged and for the new fields of work which he has opened up, but, like Sir J. C. Bose's previous volumes, the present one is often sadly lacking on the plant-physiological side. The work done is never properly related to that of previous investigators, the author confining himself to the quotation of text-books, which are often of no very recent date; in dealing with phototropism the work even of Blaauw is not mentioned. Again, Sir J. C. Bose seems so anxious to add to his collection of "plant-records" that he passes rapidly from observation to observation and from problem to problem, shedding on the way a beam of light into some of the dark places of plant physiology, but never satisfying us with a problem fully envisaged and worked out.

V. H. B.

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